



# **Vehicle Energy Consumption Evaluation System**

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**Developed by China and EU Cooperative Research program**

**Ministry of Industry and Information technology of PRC**

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# Backgrounds

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- Fuel consumption by vehicles has been bringing about more and more burdens on environmental protection and energy supply.
  - NEVs/LCVs(Low Carbon Vehicles) are one of the common choices among international community including China and EU to solve above problems.
  - Both EU and China are taking active measures to encourage the developments of NEVs /LCV.
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## Main activities

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### The Memorandum of Understanding on China and EU Cooperation Research Project on Vehicle Consumption Evaluation System Brussels, 2011-6

- Workshop in Oct,2011
  - Discussion and drafting from Oct,2010 to Oct,2012
  - Distributed for comments in Dec. 2012
  - Final draft was completed at the end of 2012.
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# Consensus and Principals

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## Consensus

1. Energy consumption of EVs should be measured and evaluated based on life cycle.
2. Power generation mix has an important impact of energy consumption of EVs
3. EVs do not promise much benefit in reducing CO<sub>2</sub> emissions currently
4. Each part of the value chain must be responsible for its relevant part – not possible to shift all responsibilities to vehicle manufacturers

## Principals

1. Thorough and objective evaluation on energy consumption during the whole life-span of EVs;
  2. Convenient to contrast on energy consumption of EVs and vehicles fueled by conventional gasoline and diesel;
  3. Convenient for the authority to take phase-in measures at different levels.
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# Basic thoughts

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- Comprehensive analysis on the main steps of energy consumption during the life cycle of vehicles.**
  - Energy losses of the upstream should be considered based on the directly measured energy consumption.**
  - China and EU work together to find out key factors influencing energy consumption evaluation and weight these factors according to their own situations.**
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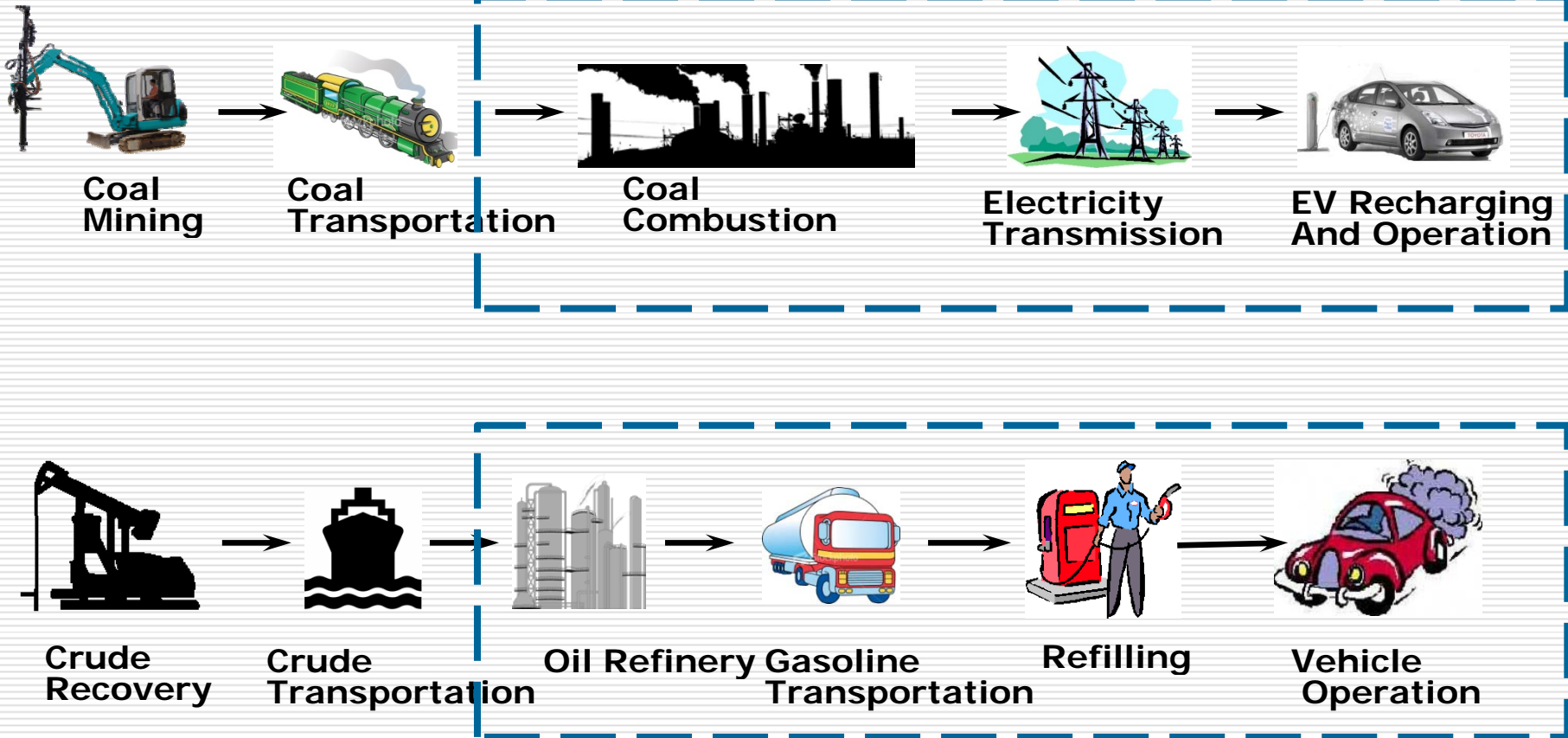
# life-cycle analysis

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Resource: HUO Hong, Tsinghua University

# Main steps

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Coal  
Combustion



Electricity  
Transmission



EV Recharging



EV Operation



Oil Refinery



Gasoline  
Transportation



Refilling



Vehicle Operation

# Step1-Power to wheel energy consumption

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Coal Combustion



Electricity Transmission



EV Recharging



EV Operation

- According to the actual measured electric energy consumption ( $E$ , kWh), the energy consumption of each element shall be traced upstream and deduced with consideration of loss of recharging, transmission (LL ratio), generation efficiency (thermal power only, the proportion of which among electricity is represented with ) and so forth, to calculate the total energy consumption( $E_L$ , kWh) corresponding to the actual electric energy consumption of the vehicle.

- In which, energy conversion efficiency in the procedure of generation, transmission and charging shall be taken into account, taken as “the factor of efficiency”, in  $F_e$

$$F_e = \frac{1}{i_{ch} \times (1 - i_{tr})} \times \left( \frac{\varphi}{s_{ge}} + (1 - \varphi) \right)$$



# Step1-Power to wheel energy consumption

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Coal  
Combustion



Electricity  
Transmission



EV  
Recharging



EV  
Operation

Electricity generation, efficiency of power generation ( $i_{ge}$ ) and rate of electric energy consumed by power house ( $i_c$ ) are taken into account together, which is represented with the electricity generation efficiency ( $s_{ge}$ ), in which electricity generation efficiency of primary energy like hydroelectricity, windmill electricity, nuclear power and so forth is calculated as 100%.

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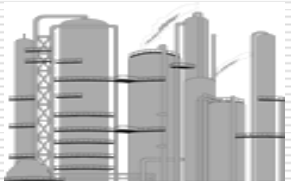
## Step2-Energy conversion based on energy conservation law

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- The electric energy(kWh) could be equivalently converted to heat(kJ) , according to **1 kWh=3600 kJ**.
- According to the lower heating value of gasoline and diesel, the equivalent fuel consumption of 1kWh electric energy consumption, namely “the factor of energy”, is represented with  $F_E$ .

## Step3-Oil factory to wheel fuel consumption

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Oil Refinery



Gasoline  
Transportation



Refilling



Vehicle Operation

Taking account of loss in process, transportation, storage and filling of fuels like gasoline and diesel, the equivalent fuel consumption ( $FC_e$ ) is calculated with fuel consumption multiplied by the process and conversion efficiency ( $R_p$ ) and the efficiency of transportation, storage and filling ( $T_p$ ).

# Instructions

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Electricity Consumption

Fuel consumption

Short-term

E

0

Mid-term

E

$$FC_e = E \times F_E$$

Long-term

E

$$FC_e = E \times F_E \times F_e \times r_p \times t_p$$

# Instructions

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- Only for equivalent calculation between electric energy and fuel consumption of EVs and plug-in hybrid vehicles, without the consideration on pollutants and CO<sub>2</sub> emission.
  - Differently take into account the steps in terms of development of EVs and plug-in hybrid vehicles, calculate the equivalent fuel consumption( $FC_e$ ) of the electric energy consumption ( $E$ )
  - Energy consumption of EVs and plug-in hybrid vehicles does not depend on vehicles only, it is influenced by energy conversion efficiency of upstream steps as well.
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# Application in China



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MIIT issued “Passenger vehicle Corporate Average Fuel Consumption Accounting Methods” on March 14, 2013, establishing annual passenger car CAFC Assessment System and implementing the unified management for all the vehicles imported and manufactured in China.

- For EV, FCV and PHEV passenger cars, the combined fuel consumption is considered to be zero. The sale volume is considered as 5 times when calculating CAFC.
- For vehicle (not including EV, FCV) whose combined fuel consumption is less than or equal to 2.8L/100km, the sale volume is considered as 3 times when calculating the corporation average fuel consumption.



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# Thanks for your attention!

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